

punctures; orifice orbicular, with a slight contraction on each side below, four or five spines round the upper margin; immediately below the centre of the lower margin a mamillary process prolonged above into a spike, and on one side of it an avicularium with pointed mandible directed upwards; ovicell — ?

In a valve of *Cardium*, from Start Bay.

40. *L. armata*, n. sp. Pl. XII. fig. 5.

Cells ovate, somewhat ventricose, granular; orifice orbicular, with a loop below, enclosed by a raised border; four very long tapering spines, two of which are placed on the upper margin and two on the sides, the latter projecting in front of the ovicell; on one (or sometimes on each) side of the orifice a raised process, bearing on the summit a small round avicularium; ovicell wide, shallow, flat in front, smooth, or with a few raised lines. Large mounted avicularia, with elongate mandibles, scattered here and there amongst the cells.

On the under side of a stone, from 30 fathoms, south-west of Polperro, forming large brownish or grey patches.

[To be continued.]

XXIII.—*On the Fibrin and Latex of Vegetables, and on the Coagulation of Fibrin without Evolution of Ammonia*. By GEORGE GULLIVER, F.R.S., Professor of Comparative Anatomy and Physiology to the Royal College of Surgeons.

THE wide diffusion of fibrin through the animal kingdom is well known. But there is little notice, much less description, of a spontaneously coagulable fluid in plants. For instance, in the last edition of our most comprehensive work on human physiology, Dr. Carpenter says there is nothing in the juices of the plant analogous to the fibrin of the blood, and, further, that “the fact of the entire absence of any substance at all resembling fibrin in the vegetable juices, and the corresponding deficiency of the fibro-gelatinous tissues in their fabric,” may be added in confirmation of an ingenious view he had advanced: this refers to limiting the value of fibrin, as regards the ordinary nutritive processes, to the maintenance of the gelatinous tissues.

It is scarcely probable that the presence of fibrin in the vegetable juices can be unknown; for the fact is that fibrin is by no means uncommon in plants—that is to say, a fluid substance which will coagulate spontaneously at the temperature of the atmosphere, and then present an intimate structure of fibrils,

I have seen this fibrin in the clear juice of many fleshy roots ; but on the present occasion it will be described from observations on the latex, and from my notes of experiments on that of numerous species of the orders Papaveraceæ, Campanulaceæ, Compositæ, Convolvulaceæ, and Urticaceæ. These are only mentioned as examples ; for the facts to be described may be witnessed in other orders.

If the latex be let out of the plant, it will commonly coagulate quickly,—in less than four minutes, if in very small quantity, as may be seen in a drop, or less, on a slip of glass. In large quantities, as of several drachms, coagulation may or may not be slower. And that this coagulation is owing to the fibrin, previously a colourless and limpid fluid, may be easily shown, both during and after its coagulation. The coagulable property is probably affected by season and temperature ; for the juice of the very same plant, which will soon coagulate spontaneously in summer, frequently requires more time or fails altogether to do so in February and the cold months. The clot is often structureless, and sometimes composed of an intimate texture of fibrils. I have seen them closely resembling those of animal fibrin, long since depicted by me (App. to Gerber's 'Anatomy,' figs. 244–246 ; and Phil. Mag. for Aug. & Sept. 1842), but less closely packed, and so forming a looser tissue, such as we are familiar with in dilute or weak forms of human fibrin.

But this vegetable fluid differs remarkably from liquor sanguinis in being often coagulable by water. So rapid or instantaneous may the effect of water on the plant-fluid be, as to remind one of the action of corrosive sublimate on albumen generally, and of water on the albuminous substance of the ova of fishes particularly.

The colour and opacity of the latex, whether white or yellow, is generally due to particles of extreme minuteness, about $\frac{1}{30000}$ English inch in diameter. These are very equal in size, form the base of the juice, and altogether closely resemble the molecular base of the chyle of Mammalia, as originally described and figured in my Appendix to Gerber's 'Anatomy.' This molecular base, with certain exceptions presently to be noticed, is the whole opake matter visible in the vegetable latex ; and the limpid fluid containing the fibrin and this molecular base are quite different parts. These parts might be respectively distinguished as the molecular base and liquor laticis.

But the milkiness or opacity of the latex of some plants, as in certain Convolvulaceæ, Cynarocephalæ, and Urticaceæ, is not owing to this molecular base, but to larger oil-like globules, of very unequal size and distinct outline. In *Convolvulus*, these globules vary from $\frac{1}{24000}$ to $\frac{1}{3000}$ inch ; in the garden Fig they

are larger and more distinct still; and of intermediate size in some species of *Carduus*.

Again, in other plants the molecular base may be present in the latex, and the fibrin quite absent, while another matter appears. This may be well observed in some Euphorbiaceæ. Thus in *Euphorbia Lathyris* and *E. Peplus* the latex will often not, and perhaps never will, coagulate spontaneously, and is little affected by the addition of water, while the latex of *E. exigua* is quickly coagulated by water. The liquor laticis and the molecular base giving opacity to the latex certainly exist together in Euphorbiaceæ. But the most remarkable objects in this juice are staff-like bodies, about $\frac{1}{800}$ inch long and $\frac{1}{6400}$ thick. These measurements were obtained in *E. Lathyris*; but they differ considerably in different species, and the objects are either swollen in the centre, like a rolling-pin, or without any such swelling, like a rod. I have examined most of the British species of this genus, and never found these staff-like bodies absent. By iodine they are instantly made much more distinct, and of a very dark-blue colour, while the molecular base and its fluid are only tinged yellow. Hence they would appear to be a form of starch, and might be called starch-sticks; and by them alone the latex of Euphorbiaceæ is very easily and certainly distinguishable from that of other orders of plants*.

The precise use of the vegetable latex is mere matter of conjecture. If, as Dr. Lindley reports ('Elements of Botany, Structural, Physiological, and Medical,' p. 9), it be conveyed to the newly formed organs, we may well suppose it, like the chyle of the highest animals, to be a provision for growth and nutrition, especially now it is shown how commonly the latex is composed of the molecular base and of either fibrin or starch, independently of whatever albumen may coexist with these.

Two hypotheses as to the origin of fibrin have been current in our day:—the first, entertained more than a century since by Sydenham, Quesnay, and Bordenave (Introduction, pp. xxvii.—xxviii., to the Sydenham Soc. edition of Hewson's Works), and revived subsequently, that the fibrin is formed at the expense of the red corpuscles of the blood; the other, very recently popular, that the fibrin is produced by the agency of the pale globules. But now we find this vegetable fibrin certainly without any free or floating cells at all.

There are two other points of view in which the characters

* Since the above was printed, I find that these bodies have been well described in Euphorbiaceæ by Schultz and others. The late Mr. Quekett figured them, like two-headed clubs, in *E. splendens*.

or properties of the latex appear interesting :—first, that the plant-juices may afford some help to classification ; and secondly, as regards the most recent doctrine as to the cause of the coagulation of the blood. Thus we have seen a very characteristic and plain fact in the latex of Euphorbiaceæ. Nor is it any longer doubtful that a mere microscopic part may show the difference, even more generally than any one single and large character whatever, between two great divisions of the animal kingdom. For, since the publication of my observations, in the Appendix to the English version of Gerber's 'Anatomy,' it has become generally admitted that the presence or not of the nucleus in the red corpuscle of the blood of Vertebrata is a true difference between Mammalia and the three lower classes, and that this simple character is applicable to all ages, sexes, and conditions—of course excluding that early period of intra-uterine life when, as I have long since shown, the temporary red corpuscle of Mammalia is the true analogue of the permanent red corpuscle of oviparous Vertebrata. And, to revert to the vegetable latex, Mr. Babington, who has so much advanced our knowledge of British botany, has already adopted specific characters derived from the colour of the juice in the genus *Papaver*.

As to the cause of the coagulation of the blood, any theory that does not include the fibrin of other parts is not likely to prove satisfactory. Dr. Richardson, in his elaborate and valuable work, assigns as the cause for that coagulation the evolution of the volatile alkali ; and I believe his view already passes current in some of our systematic treatises. Now, I have tested these vegetable-juices so often, and always in vain, for ammoniacal vapour, that I believe the fibrin in them coagulates quite independently of any evolution of ammonia. Besides the microscopic test, so much insisted on by Dr. Richardson, other trials were made, like those described by Dr. Davy (and with the same negative results) in his examination of coagulating blood. And so I found, too, in spontaneously coagulable mixtures of serum ; no evolution of even a trace of ammonia could be detected during the coagulation. These observations are not adduced as conclusive against this chemical view of the cause of the coagulation of the blood, but merely as examples of the obstructions which at present lie in the way of a free admission of that view.

Edenbridge, Jan. 31, 1862.